



# STGB8NC60KD - STGD8NC60KD STGP8NC60KD

N-channel 600V - 8A - D<sup>2</sup>PAK / DPAK / TO-220  
Short circuit rated PowerMESH™ IGBT

## Features

Type	V <sub>CES</sub>	V <sub>CE(sat)</sub> Typ @25°C	I <sub>C</sub> @100°C
STGB8NC60KD	600V	2.2V	8A
STGD8NC60KD	600V	2.2V	8A
STGP8NC60KD	600V	2.2V	8A

- Lower on voltage drop (V<sub>cesat</sub>)
- Lower C<sub>RES</sub> / C<sub>IES</sub> ratio (no cross-conduction susceptibility)
- Very soft ultra fast recovery antiparallel diode
- Short circuit withstand time 10μs

## Applications

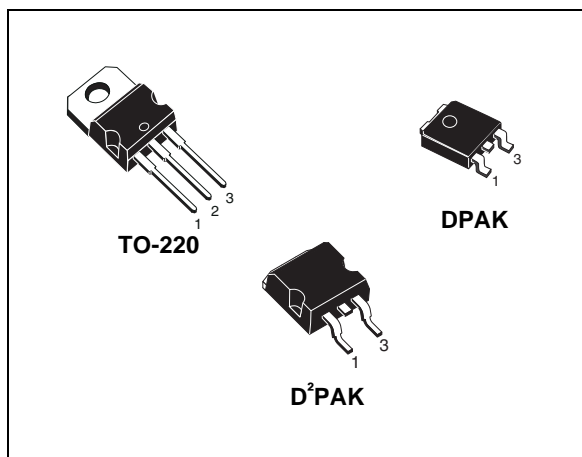
- High frequency motor controls
- SMPS and PFC in both hard switch and resonant topologies
- Motor drivers

## Description

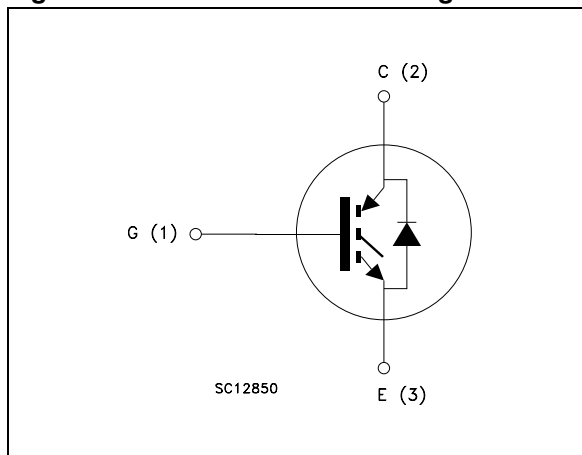
Using the latest high voltage technology based on a patented strip layout, STMicroelectronics has designed an advanced family of IGBTs, the PowerMESH™ IGBTs, with outstanding performances. The suffix "K" identifies a family optimized for high frequency motor control applications with short circuit withstand capability.

**Table 1. Device summary**

Order codes	Marking	Package	Packaging
STGB8NC60KD	GB8NC60KD	D <sup>2</sup> PAK	Tape & reel
STGD8NC60KD	GD8NC60KD	DPAK	Tape & reel
STGP8NC60KD	GP8NC60KD	TO-220	Tube



**Figure 1. Internal schematic diagram**



# Contents

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# 1 Electrical ratings

**Table 2. Absolute maximum ratings**

Symbol	Parameter	Value		Unit
		D <sup>2</sup> PAK/TO-220	DPAK	
V <sub>CES</sub>	Collector-emitter voltage (V <sub>GS</sub> = 0)	600		V
I <sub>C</sub> <sup>(1)</sup>	Collector current (continuous) at T <sub>C</sub> = 25°C	15		A
I <sub>C</sub> <sup>(1)</sup>	Collector current (continuous) at T <sub>C</sub> = 100°C	8		A
I <sub>CP</sub> <sup>(2)</sup>	Pulsed collector current	30		A
V <sub>GE</sub>	Gate-emitter voltage	±20		V
I <sub>F</sub>	Diode RMS forward current at T <sub>C</sub> =25°C	7		A
I <sub>FSM</sub>	Surge not repetitive forward current tp = 10ms sinusoidal	20		A
P <sub>TOT</sub>	Total dissipation at T <sub>C</sub> = 25°C	65	62	W
T <sub>j</sub>	Operating junction temperature	– 55 to 150		°C
T <sub>scw</sub>	Short circuit withstand time	10		µs

1. Calculated according to the iterative formula:

$$I_C(T_C) = \frac{T_{JMAX} - T_C}{R_{THJ-C} \times V_{CESAT(MAX)}(T_C, I_C)}$$

2. Pulse width limited by max junction temperature

**Table 3. Thermal resistance**

Symbol	Parameter		Value	Unit
R <sub>thj-case</sub>	Thermal resistance junction-case max IGBT	TO-220 / D <sup>2</sup> PAK	1.9	°C/W
		DPAK	2.0	°C/W
R <sub>thj-case</sub>	Thermal resistance junction-case max diode	TO-220 / D <sup>2</sup> PAK	4	°C/W
		DPAK	4.5	°C/W
R <sub>thj-amb</sub>	Thermal resistance junction-ambient Max		62.5	°C/W

## 2 Electrical characteristics

( $T_{CASE}=25^{\circ}C$  unless otherwise specified)

**Table 4. Static**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{BR(CES)}$	Collector-emitter breakdown voltage	$I_C = 1\text{mA}, V_{GE} = 0$	600			V
$V_{CE(sat)}$	Collector-emitter saturation voltage	$V_{GE} = 15\text{V}, I_C = 3\text{A}$ $V_{GE} = 15\text{V}, I_C = 3\text{A}, T_C = 125^{\circ}C$		2.2 1.8	2.75	V V
$V_{GE(th)}$	Gate threshold voltage	$V_{CE} = V_{GE}, I_C = 250\ \mu\text{A}$	4.5		6.5	V
$I_{CES}$	Collector cut-off current ( $V_{GE} = 0$ )	$V_{CE} = \text{Max rating}, T_C = 25^{\circ}C$ $V_{CE} = \text{Max rating}, T_C = 125^{\circ}C$			150 1	$\mu\text{A}$ mA
$I_{GES}$	Gate-emitter leakage current ( $V_{CE} = 0$ )	$V_{GE} = \pm 20\text{V}, V_{CE} = 0$			$\pm 100$	nA
$g_{fs}$	Forward transconductance	$V_{CE} = 15\text{V}, I_C = 3\text{A}$		15		S

**Table 5. Dynamic**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$C_{ies}$	Input capacitance	$V_{CE} = 25\text{V}, f = 1\text{MHz},$ $V_{GE} = 0$		380		pF
$C_{oes}$	Output capacitance			46		pF
$C_{res}$	Reverse transfer capacitance			8.5		pF
$Q_g$	Total gate charge	$V_{CE} = 390\text{V}, I_C = 3\text{A},$		19		nC
$Q_{ge}$	Gate-emitter charge	$V_{GE} = 15\text{V},$		5		nC
$Q_{gc}$	Gate-collector charge	(see Figure 19)		9		nC

**Table 6. Switching on/off (inductive load)**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$ $t_r$ $(di/dt)_{on}$	Turn-on delay time Current rise time Turn-on current slope	$V_{CC} = 390V, I_C = 3A$ $R_G = 10\Omega, V_{GE} = 15V,$ $T_J = 25^\circ C$ <i>(see Figure 20)</i>		17 6 655		ns ns A/ $\mu s$
$t_{d(on)}$ $t_r$ $(di/dt)_{on}$	Turn-on delay time Current rise time Turn-on current slope	$V_{CC} = 390V, I_C = 3A$ $R_G = 10\Omega, V_{GE} = 15V,$ $T_J = 125^\circ C$ <i>(see Figure 20)</i>		16.5 6.5 575		ns ns A/ $\mu s$
$t_r(V_{off})$ $t_{d(off)}$ $t_f$	Off voltage rise time Turn-off delay time Current fall time	$V_{CC} = 390V, I_C = 3A,$ $R_{GE} = 10\Omega, V_{GE} = 15V,$ $T_J = 25^\circ C$ <i>(see Figure 20)</i>		33 72 82		ns ns ns
$t_r(V_{off})$ $t_{d(off)}$ $t_f$	Off voltage rise time Turn-off delay time Current fall time	$V_{CC} = 390V, I_C = 3A,$ $R_{GE} = 10\Omega, V_{GE} = 15V,$ $T_J = 125^\circ C$ <i>(see Figure 20)</i>		60 106 136		ns ns ns

**Table 7. Switching energy (inductive load)**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$E_{on}^{(1)}$ $E_{off}^{(2)}$ $E_{ts}$	Turn-on switching losses Turn-off switching losses Total switching losses	$V_{CC} = 390V, I_C = 3A$ $R_G = 10\Omega, V_{GE} = 15V, T_J = 25^\circ C$ <i>(see Figure 20)</i>		55 85 140		$\mu J$ $\mu J$ $\mu J$
$E_{on}^{(1)}$ $E_{off}^{(2)}$ $E_{ts}$	Turn-on switching losses Turn-off switching losses Total switching losses	$V_{CC} = 390V, I_C = 3A$ $R_G = 10\Omega, V_{GE} = 15V,$ $T_J = 125^\circ C$ <i>(see Figure 20)</i>		87 162 249		$\mu J$ $\mu J$ $\mu J$

1.  $E_{on}$  is the turn-on losses when a typical diode is used in the test circuit in figure 2. If the IGBT is offered in a package with a co-pak diode, the co-pack diode is used as external diode. IGBTs & Diode are at the same temperature (25°C and 125°C)
2. Turn-off losses include also the tail of the collector current

Table 8. Collector-emitter diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_f$	Forward on-voltage	$I_f = 3A$		1.6	2.1	V
		$I_f = 3A, T_j = 125^\circ C$		1.3		V
$t_{rr}$	Reverse recovery time	$I_f = 3A, V_R = 30V,$		23.5		ns
$Q_{rr}$	Reverse recovery charge	$T_j = 25^\circ C, di/dt = 100 A/\mu s$		16.5		nC
$I_{rrm}$	Reverse recovery current	(see Figure 21)		1.4		A
$t_{rr}$	Reverse recovery time	$I_f = 3A, V_R = 30V,$		39		ns
$Q_{rr}$	Reverse recovery charge	$T_j = 125^\circ C, di/dt = 100A/\mu s$		39		nC
$I_{rrm}$	Reverse recovery current	(see Figure 21)		2		A

## 2.1 Electrical characteristics (curves)

Figure 2. Output characteristics

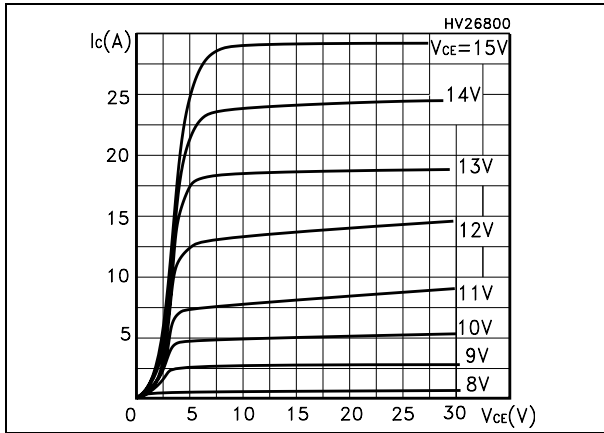


Figure 3. Transfer characteristics

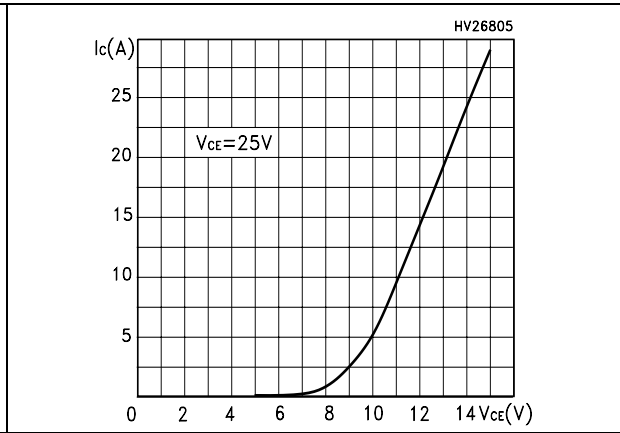


Figure 4. Transconductance

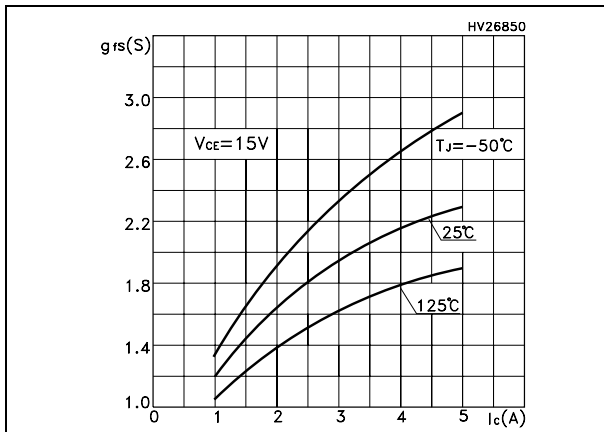


Figure 5. Collector-emitter on voltage vs temperature

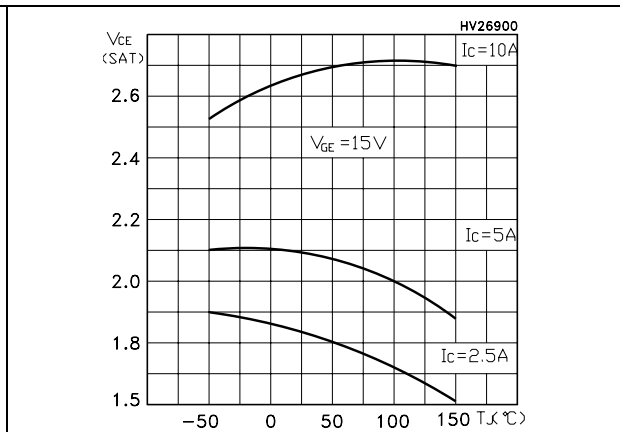
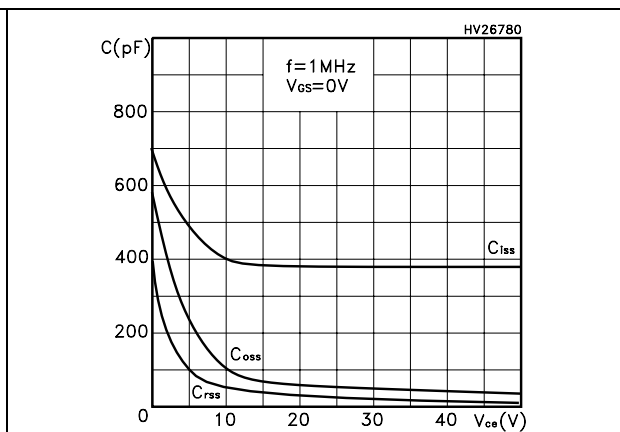
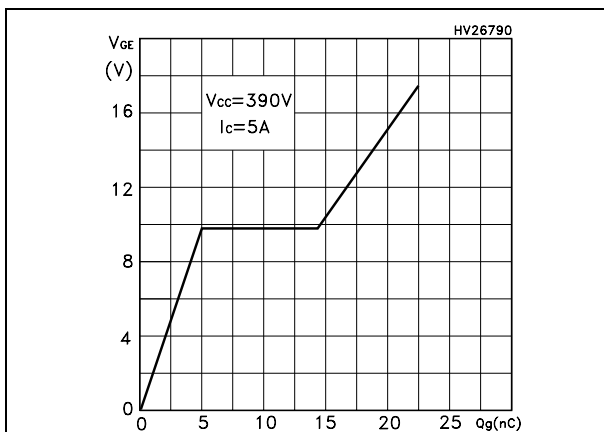
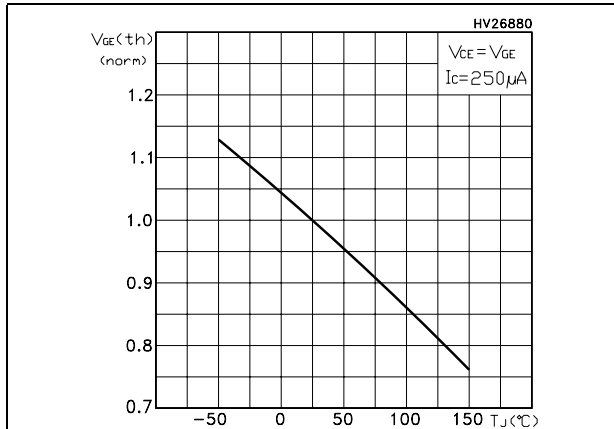


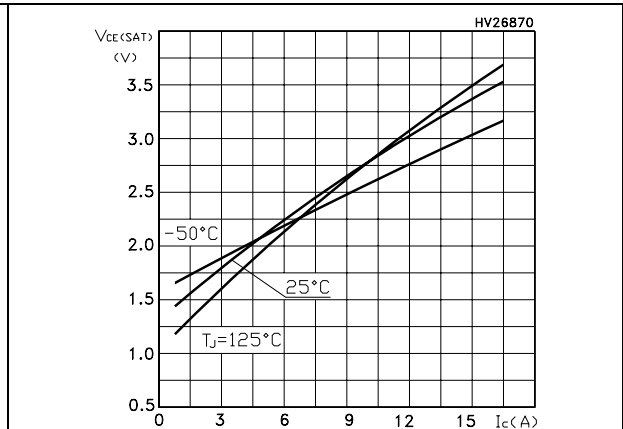
Figure 6. Gate charge vs gate-source voltage Figure 7. Capacitance variations



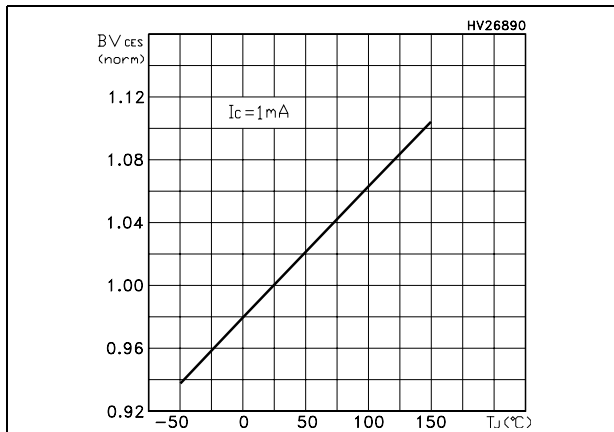
**Figure 8. Normalized gate threshold voltage vs temperature**



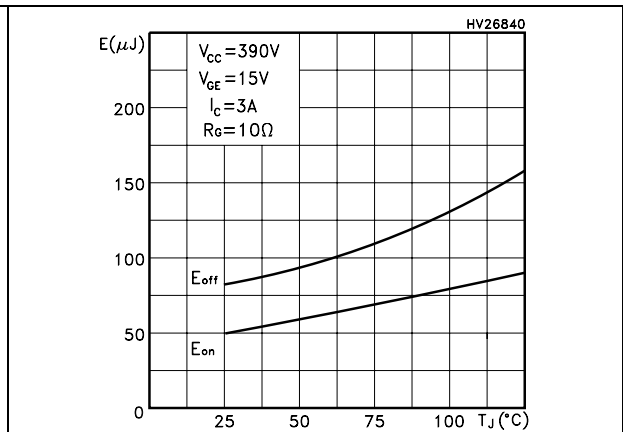
**Figure 9. Collector-emitter on voltage vs collector current**



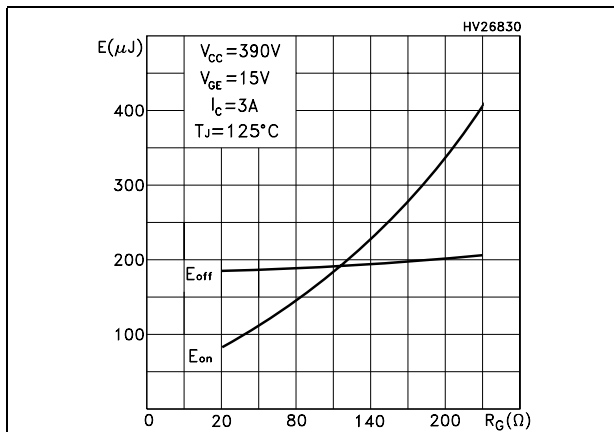
**Figure 10. Normalized breakdown voltage vs temperature**



**Figure 11. Switching losses vs temperature**



**Figure 12. Switching losses vs gate resistance**



**Figure 13. Switching losses vs collector current**

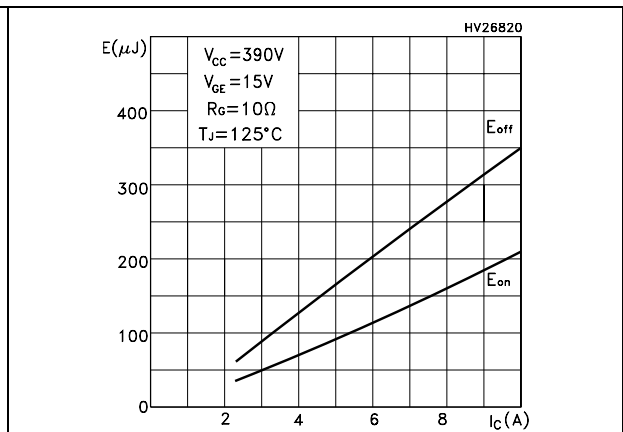




Figure 14. Thermal impedance for TO-220/  
D<sup>2</sup>PAK

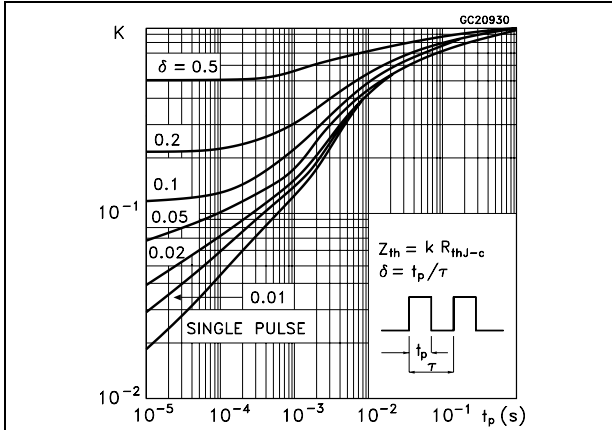


Figure 15. Turn-off SOA

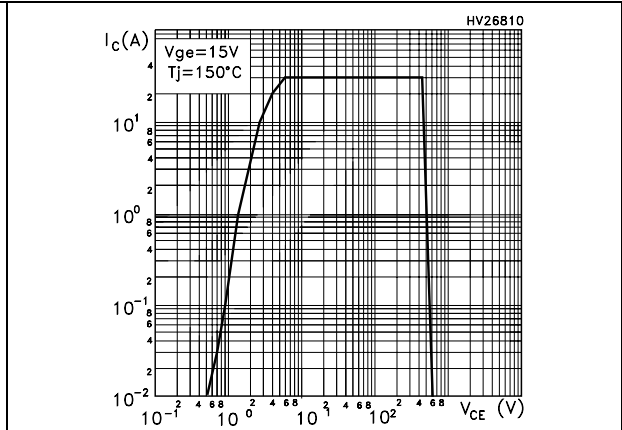


Figure 16. Forward voltage drop versus  
forward current

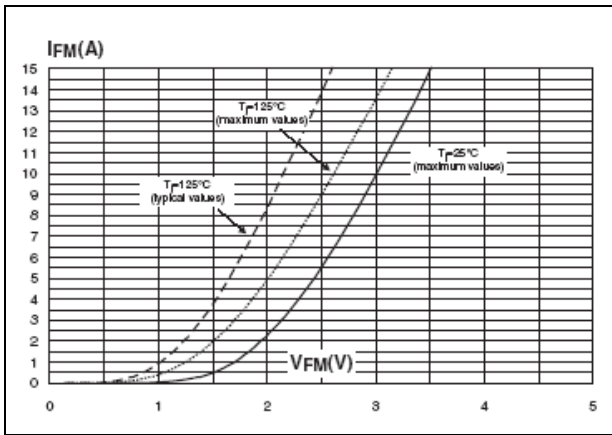
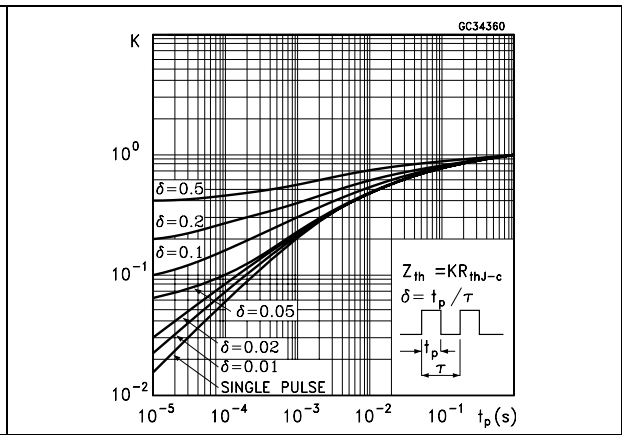


Figure 17. Thermal impedance for DPAK



### 3 Test circuit

Figure 18. Test circuit for inductive load switching

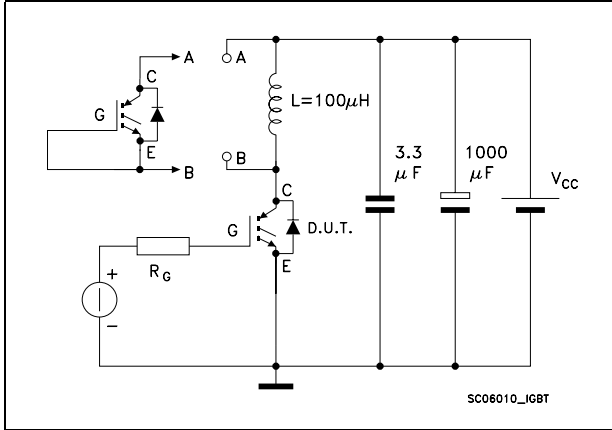


Figure 19. Gate charge test circuit

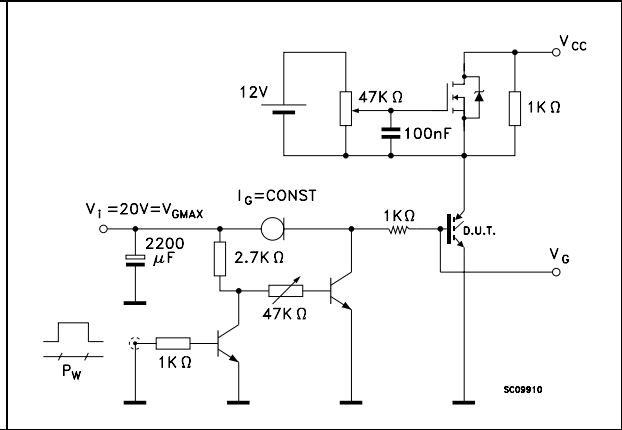


Figure 20. Switching waveform

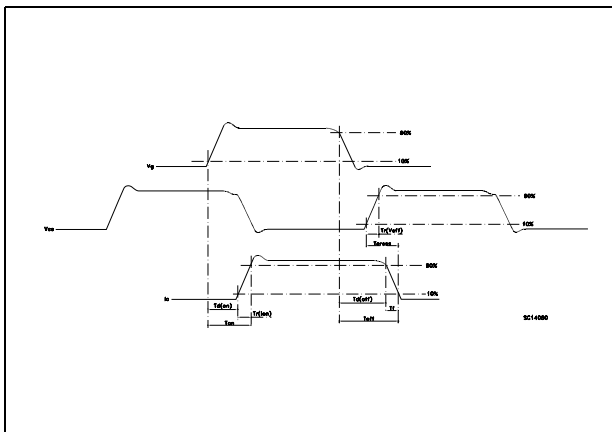
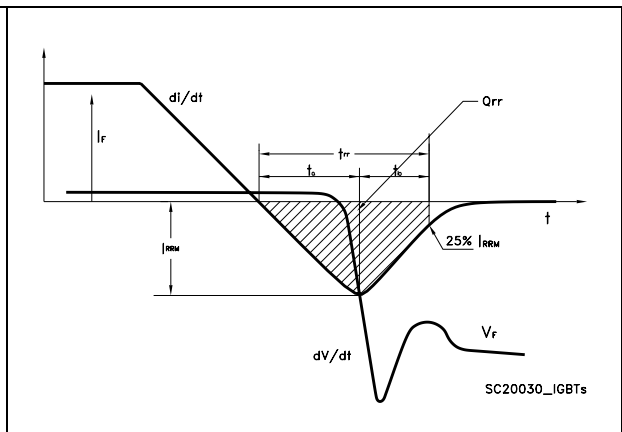


Figure 21. Diode recovery time waveform

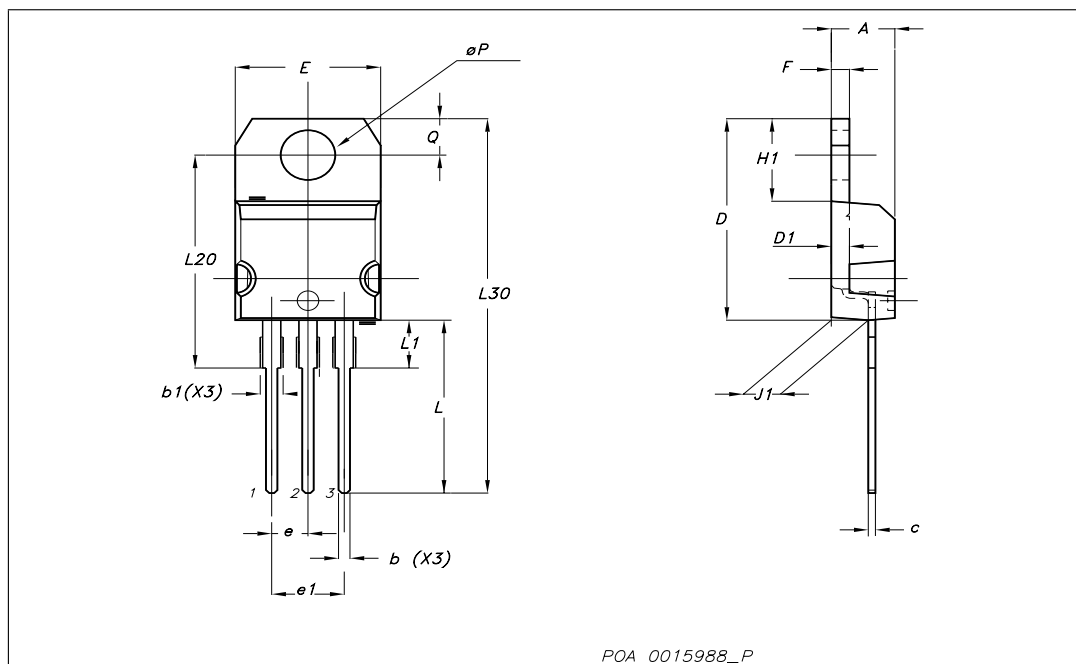


## 4 Package mechanical data

In order to meet environmental requirements, ST offers these devices in ECOPACK® packages. These packages have a Lead-free second level interconnect. The category of second level interconnect is marked on the package and on the inner box label, in compliance with JEDEC Standard JESD97. The maximum ratings related to soldering conditions are also marked on the inner box label. ECOPACK is an ST trademark. ECOPACK specifications are available at: [www.st.com](http://www.st.com)

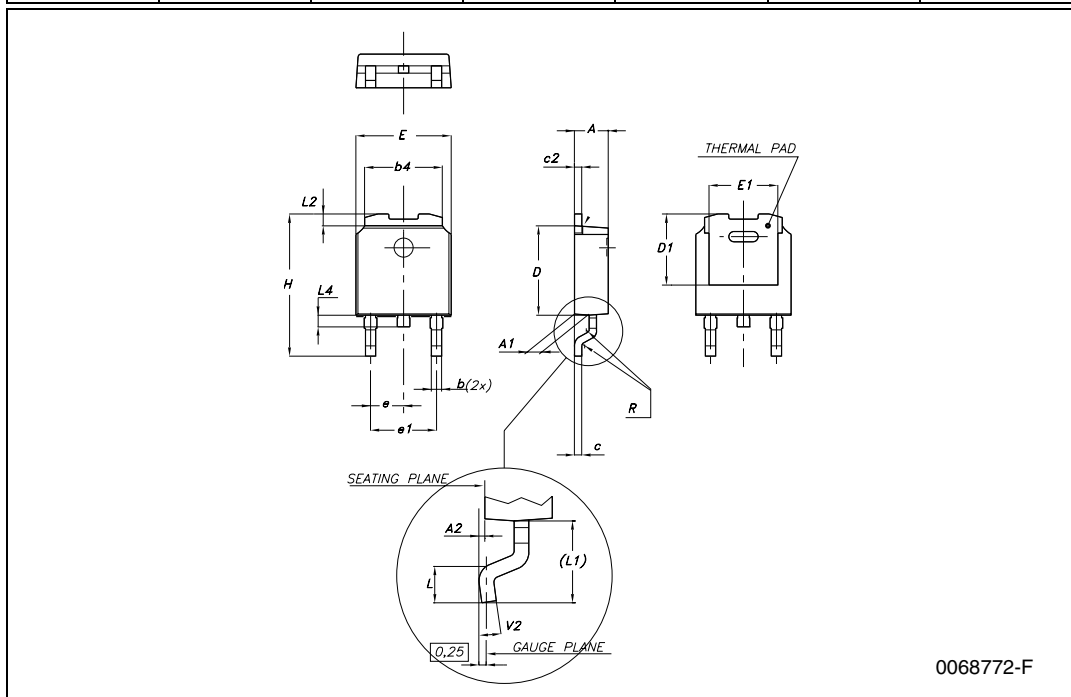
TO-220 mechanical data

Dim	mm			inch		
	Min	Typ	Max	Min	Typ	Max
A	4.40		4.60	0.173		0.181
b	0.61		0.88	0.024		0.034
b1	1.14		1.70	0.044		0.066
c	0.49		0.70	0.019		0.027
D	15.25		15.75	0.6		0.62
D1		1.27			0.050	
E	10		10.40	0.393		0.409
e	2.40		2.70	0.094		0.106
e1	4.95		5.15	0.194		0.202
F	1.23		1.32	0.048		0.051
H1	6.20		6.60	0.244		0.256
J1	2.40		2.72	0.094		0.107
L	13		14	0.511		0.551
L1	3.50		3.93	0.137		0.154
L20		16.40			0.645	
L30		28.90			1.137	
∅P	3.75		3.85	0.147		0.151
Q	2.65		2.95	0.104		0.116



**DPAK MECHANICAL DATA**

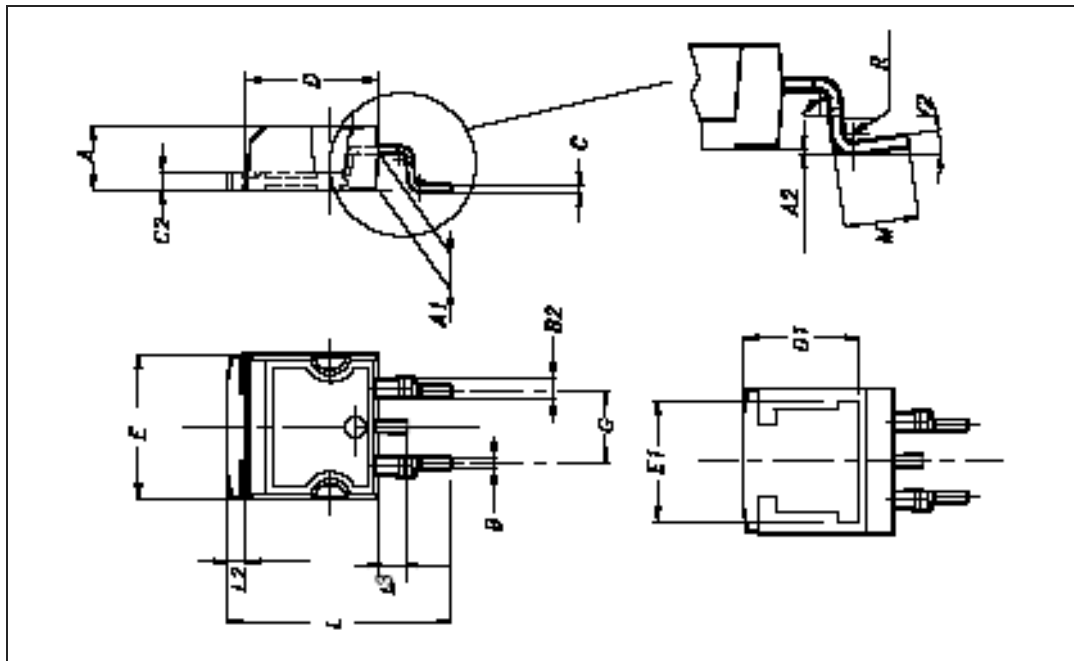
DIM.	mm.			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A	2.2		2.4	0.086		0.094
A1	0.9		1.1	0.035		0.043
A2	0.03		0.23	0.001		0.009
B	0.64		0.9	0.025		0.035
b4	5.2		5.4	0.204		0.212
C	0.45		0.6	0.017		0.023
C2	0.48		0.6	0.019		0.023
D	6		6.2	0.236		0.244
D1		5.1			0.200	
E	6.4		6.6	0.252		0.260
E1		4.7			0.185	
e		2.28			0.090	
e1	4.4		4.6	0.173		0.181
H	9.35		10.1	0.368		0.397
L	1			0.039		
(L1)		2.8			0.110	
L2		0.8			0.031	
L4	0.6		1	0.023		0.039
R		0.2			0.008	
V2	0°		8°	0°		8°



0068772-F

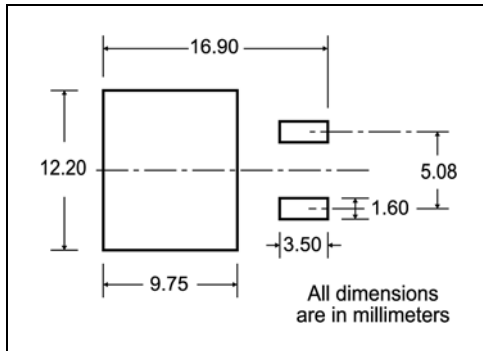
**D<sup>2</sup>PAK mechanical data**

Dim	mm			inch		
	Min	Typ	Max	Min	Typ	Max
A	4.4		4.6	0.173		0.181
A1	2.49		2.69	0.098		0.106
A2	0.03		0.23	0.001		0.009
B	0.7		0.93	0.027		0.036
B2	1.14		1.7	0.044		0.067
C	0.45		0.6	0.017		0.023
C2	1.23		1.36	0.048		0.053
D	8.95		9.35	0.352		0.368
D1		8			0.315	
E	10		10.4	0.393		0.409
E1		8.5			0.334	
G	4.88		5.28	0.192		0.208
L	15		15.85	0.590		0.625
L2	1.27		1.4	0.50		0.55
L3	1.4		1.75	0.055		0.68
M	2.4		3.2	0.094		0.126
R		0.4			0.015	
V2	0°		4°			



# 5 Packaging mechanical data

## D<sup>2</sup>PAK FOOTPRINT



## TAPE AND REEL SHIPMENT

**TAPE MECHANICAL DATA**

DIM.	mm		inch	
	MIN.	MAX.	MIN.	MAX.
A0	10.5	10.7	0.413	0.421
B0	15.7	15.9	0.618	0.626
D	1.5	1.6	0.059	0.063
D1	1.59	1.61	0.062	0.063
E	1.65	1.85	0.065	0.073
F	11.4	11.6	0.449	0.456
K0	4.8	5.0	0.189	0.197
P0	3.9	4.1	0.153	0.161
P1	11.9	12.1	0.468	0.476
P2	1.9	2.1	0.075	0.082
R	50		1.574	
T	0.25	0.35	0.0098	0.0137
W	23.7	24.3	0.933	0.956

**REEL MECHANICAL DATA**

DIM.	mm		inch	
	MIN.	MAX.	MIN.	MAX.
A		330		12.992
B	1.5		0.059	
C	12.8	13.2	0.504	0.520
D	20.2		0.795	
G	24.4	26.4	0.960	1.039
N	100		3.937	
T		30.4		1.197

BASE QTY	BULK QTY
1000	1000

10 pitches cumulative tolerance on tape +/- 0.2 mm

Center line of cavity

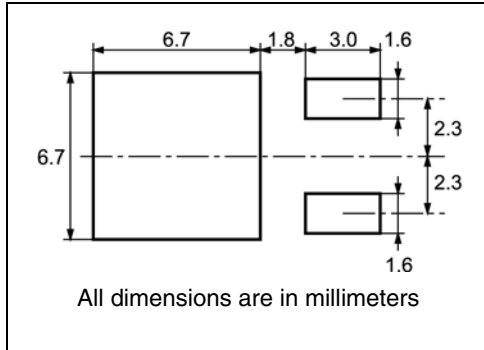
User Direction of Feed

FEED DIRECTION

Bending radius R min.

\* on sales type

**DPAK FOOTPRINT**



**TAPE AND REEL SHIPMENT**

40 mm min. Access hole at slot location

Full radius

Tape slot in core for tape start 2.5mm min. width

G measured at hub

**REEL MECHANICAL DATA**

DIM.	mm		inch	
	MIN.	MAX.	MIN.	MAX.
A		330		12.992
B	1.5		0.059	
C	12.8	13.2	0.504	0.520
D	20.2		0.795	
G	16.4	18.4	0.645	0.724
N	50		1.968	
T		22.4		0.881

**TAPE MECHANICAL DATA**

DIM.	mm		inch	
	MIN.	MAX.	MIN.	MAX.
A0	6.8	7	0.267	0.275
B0	10.4	10.6	0.409	0.417
B1		12.1		0.476
D	1.5	1.6	0.059	0.063
D1	1.5		0.059	
E	1.65	1.85	0.065	0.073
F	7.4	7.6	0.291	0.299
K0	2.55	2.75	0.100	0.108
P0	3.9	4.1	0.153	0.161
P1	7.9	8.1	0.311	0.319
P2	1.9	2.1	0.075	0.082
R	40		1.574	
W	15.7	16.3	0.618	0.641

**BASE QTY** | **BULK QTY**

2500 | 2500

TOP COVER TAPE

10 pitches cumulative tolerance on tape +/- 0.2 mm

Center line of cavity

User Direction of Feed

FEED DIRECTION

Bending radius R min.



## 6 Revision history

Table 9. Document revision history

Date	Revision	Changes
02-Oct-2007	1	First release

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